MID-FLIGHT TRUNK MOTION INCREASED UNILATERAL LOADING DURING LANDING: A CENTER OF MASS ANALYSIS

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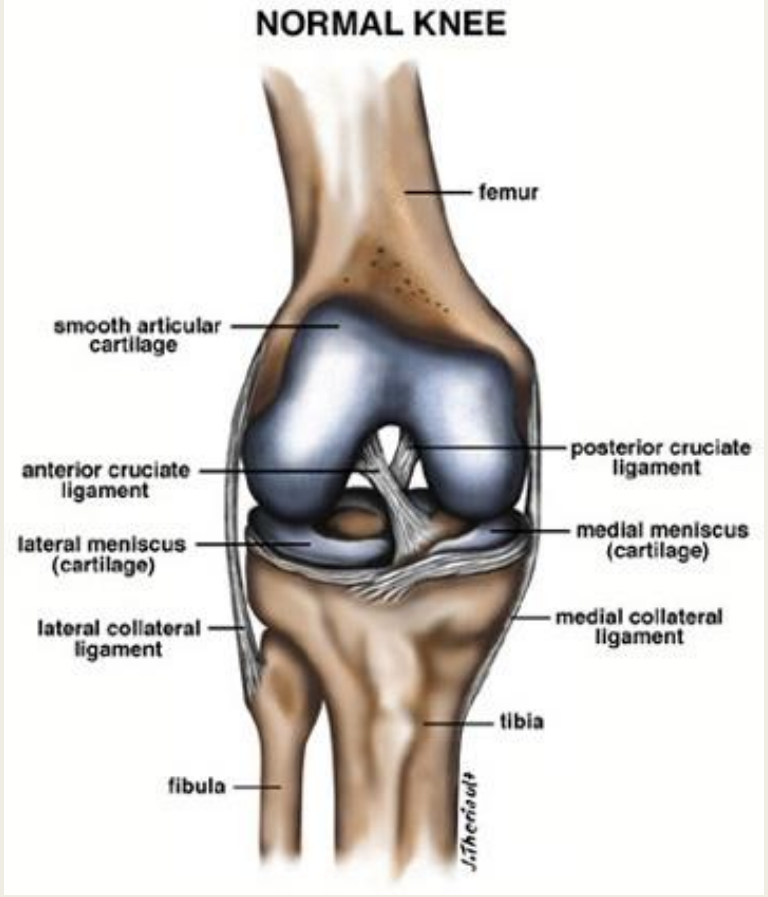
Literature Review



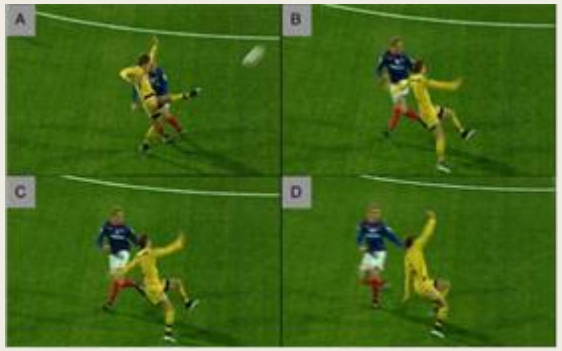
- Background Information
  - *ACL injury*
    - Most common orthopedic repair
      - *(Ferrtti et al., 2010)*
    - ACL injury is the most frequent severe injury in many NCAA sports events, with an injury rate of 0.15 per 1000 athlete-exposures (Kay *et al.,* 2017; Hootman, Dick, & Agel, 2007)
    - Often at least 6 months before return to sport (Kvist, 2004)

Literature Review

- Injury Conditions
  - *Non- contact* (Tarmah, Rahnama, & Khayambashi, *2010)*
  - *Jump-landing and cutting* (Dai *et al., 2015;* Koga *et al., 2010;* Krosshaug *et al., 2007)*
- Landing Biomechanics
  - *Knee flexion angle*
    - Stiff landing technique (Devita & Skelly, 1992; Leppanen *et al.,* 2016)
    - Associated with impact forces (Podraza & White, 2010)
    - Equal muscular strength between the quadriceps and hamstrings (Nagai et al, 2013).

Literature Review

- Unilateral landings
  - *Greater ground reaction force* (Yeow, Lee, & Goh, 2010)
  - *Decreased maximum knee flexion angle* (Yeow, Lee, & Goh, 2010)
- Trunk motion
  - *ACL injuries often occurred when trunk motion was present* (Stuiecken *et al.,* 2015; Walden *et al.,* 2015; Hewett, Torg, & Boden, 2009)



Purpose

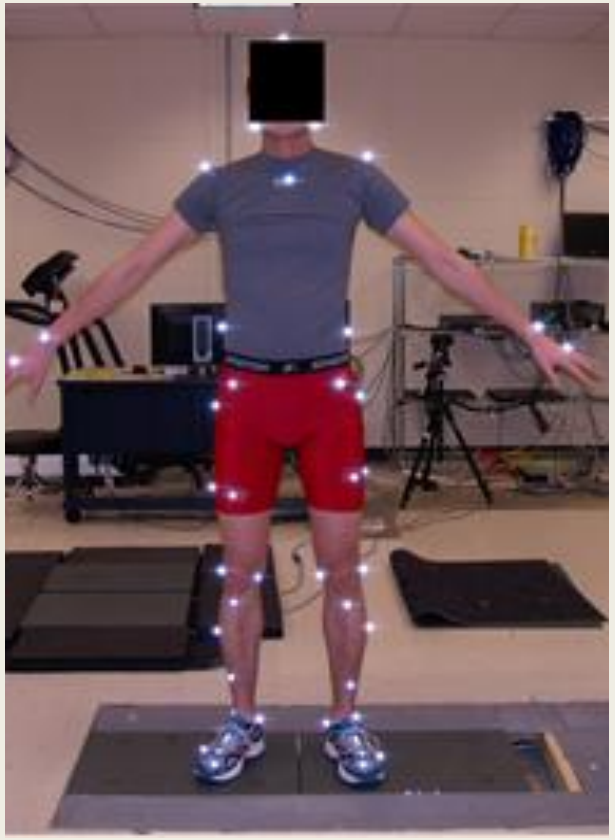
- The purpose of the current study was to quantify the effect of mid-flight medial-lateral trunk motion on center of mass (COM) distribution and subsequent landing biomechanics.

Hypothesis

- It was hypothesized that medial-lateral trunk motion would cause medial-lateral leg movements in the opposite direction, resulting in asymmetric landing and increased vertical ground reaction force (VGRF) to the leg closer to the total body COM.

Methodology

- 41 (18 male, 23 female) recreationally active participants
  - *Age: 22.0 ± 3.0 years*
  - *Height: 1.74 ± 0.10 meters*
  - *Mass: 71.0 ± 13.9 kilograms*
- 44 retro-reflective markers used for COM analysis
- 8 3D Cameras
- Vicon Nexus
- 2 Bertec Force Plates



Methodology

- Protocol
  - *3 trials were completed in each of the 3 jump-landing conditions (Up, Right-reaching, and Left-reaching)*
  - *Order was randomized*

Methodology

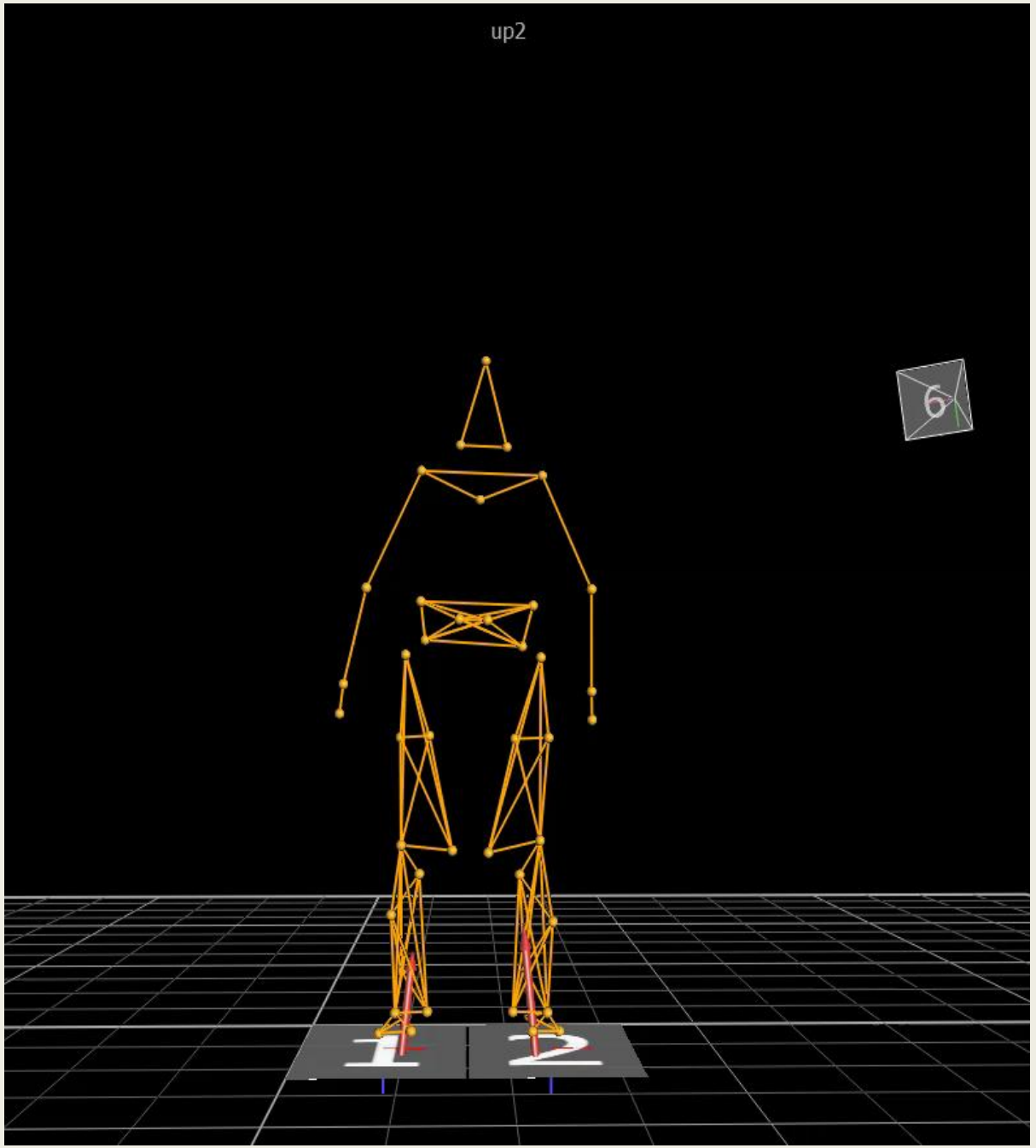
- ”Up” Condition

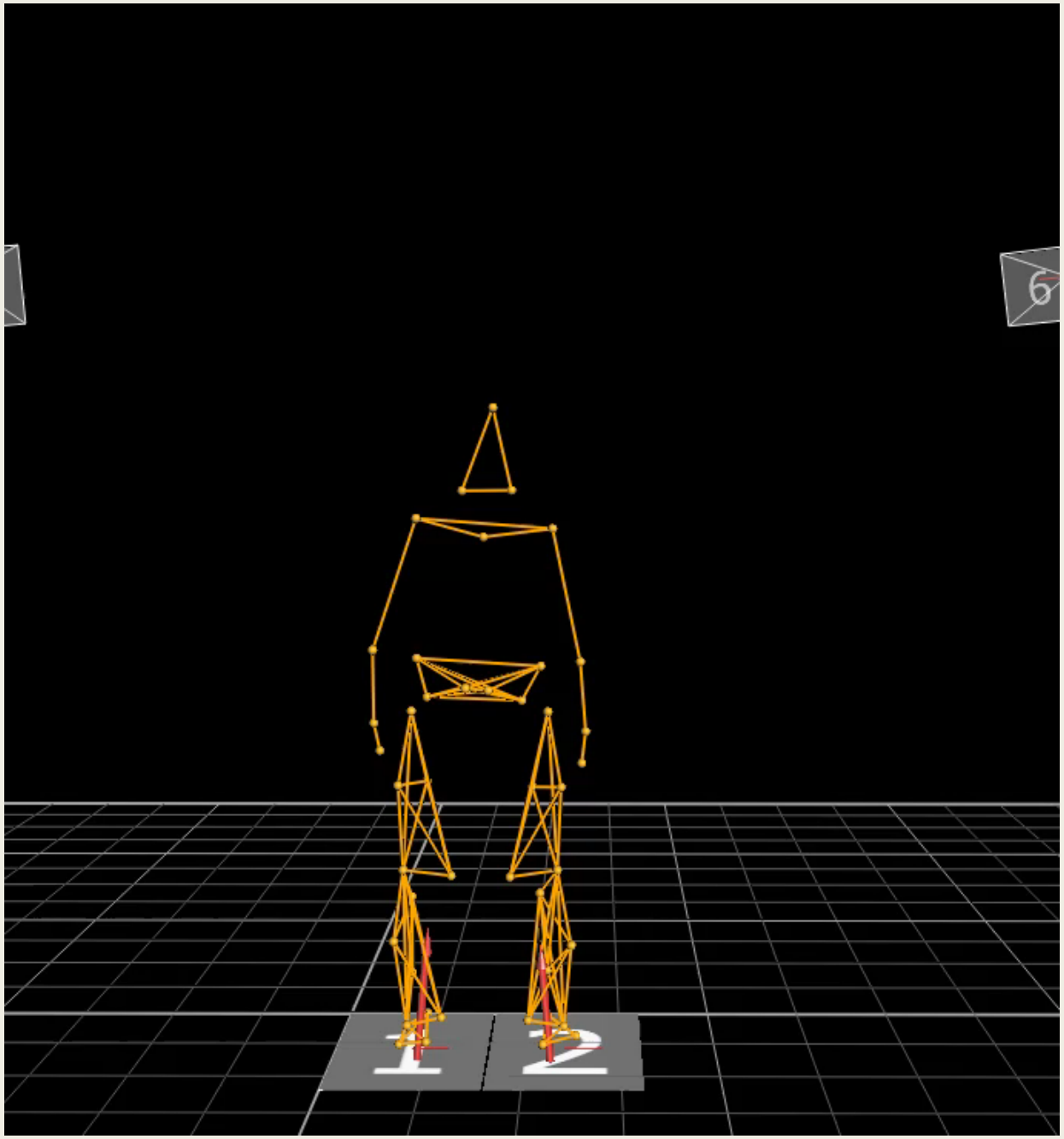
Methodology

- “Right-reaching” Condition

Methodology

- “Left-reaching” Condition


up2
6
1
2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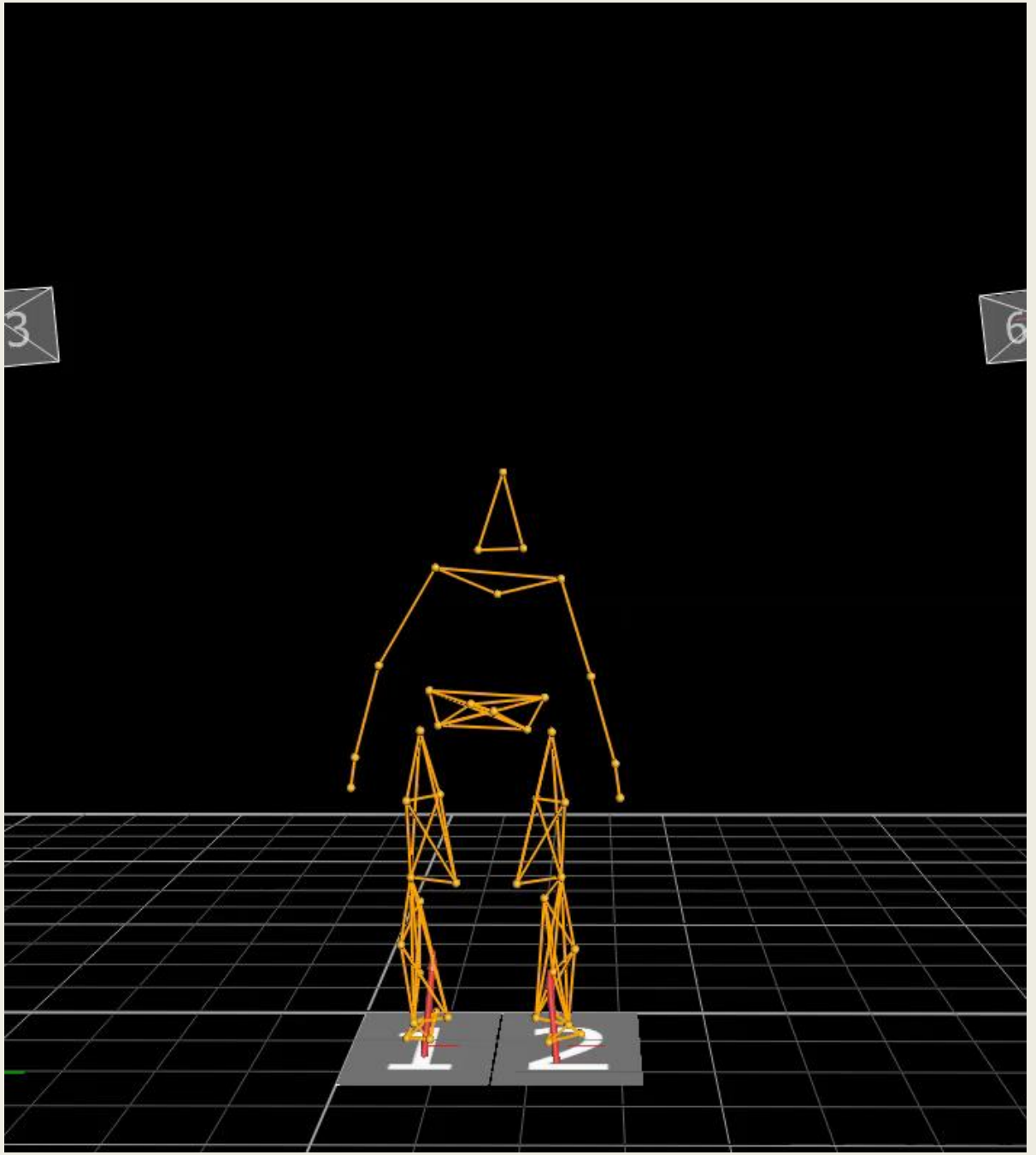
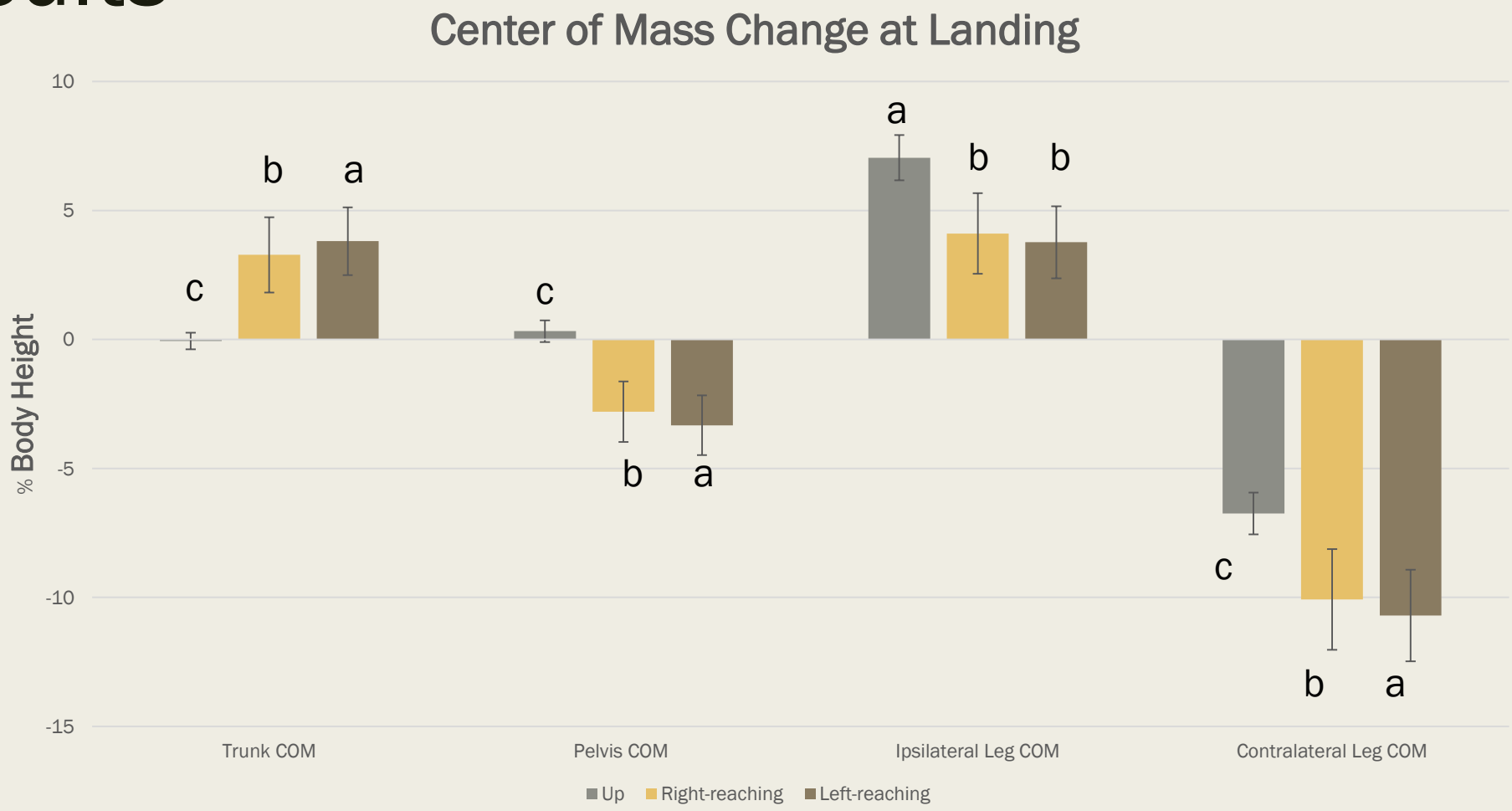

3
6
1
2

Results

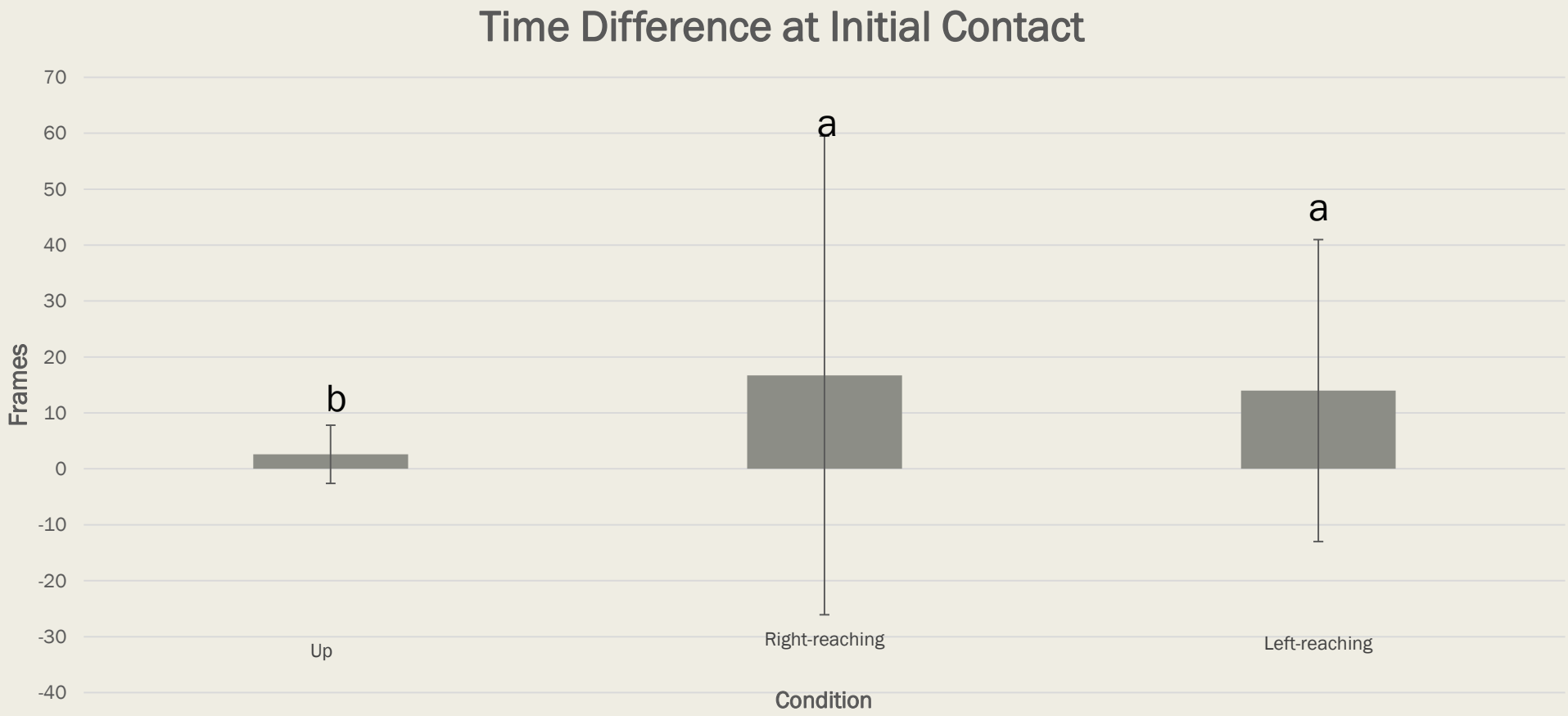
- COM Analysis (% Body Height difference from Total Body COM)
  - *Upper Body COM*
  - *Pelvis COM*
  - *Ipsilateral Leg COM*
  - *Contralateral Leg COM*
- Landing Times (frames)
  - *Ipsilateral Leg*
  - *Contralateral Leg*
- Peak Vertical Ground Reaction Force (VGRF) (Force as proportion of Body Weight)
  - *Ipsilateral Leg*
  - *Contralateral Leg*

Results



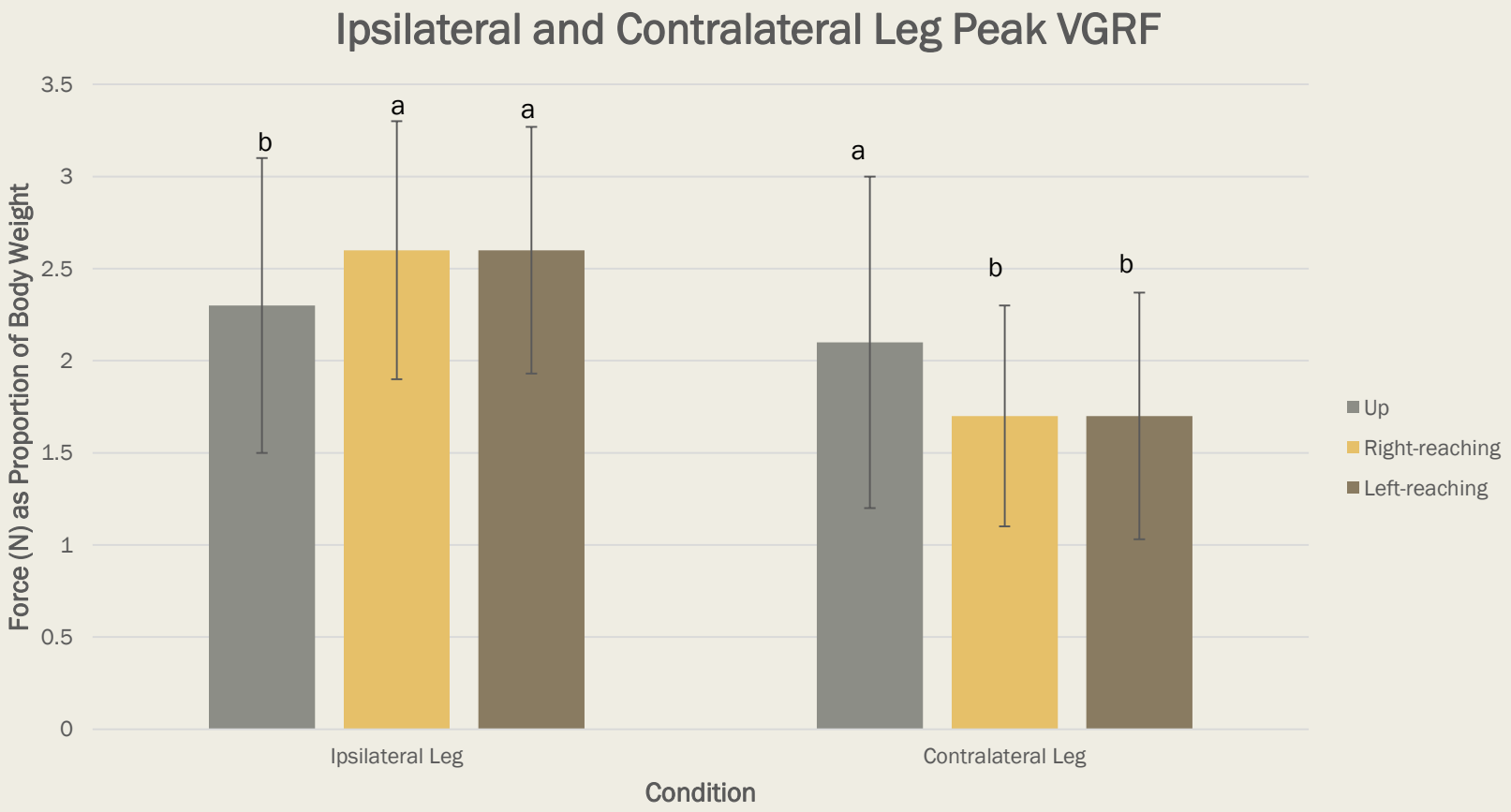
Note: a>b>c at a significance level of 0.05

Results



Note: a>b>c at a significance level of 0.05

Results



Note: a>b>c at a significance level of 0.05

Discussion

- Implications
  - *Racket and jumping sports*
    - In volleyball and badminton, most ACL injury cases involving a jump-landing, occurred in the knee opposite the spiking or racket arm (dominant arm; Devetag *et al.,* 2016; Kimura *et al.,* 2014).
- Recommendations
  - *Returning to natural, vertical position*
  - *Increase knee and hip flexion for a softer landing*
  - *Decrease muscular asymmetries*
  - *Adapt effective falling strategies*

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■Thank you!

- Questions?